

REMARKS

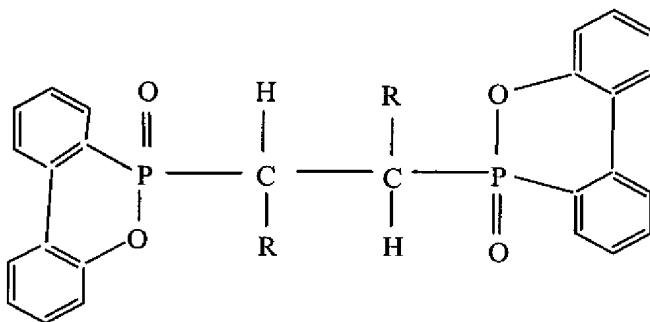
Claims 1 through 8 and new Claims 9 and 10 are pending in the application.

Claim 6 has been amended to correct a typographical error.

Claims 9 and 10 have been added to complete the record for examination and highlight advantageous embodiments of the invention.

Claim 9 is directed to advantageous methods for producing reactive organic compounds containing poly-DOPO as claimed in claim 1, wherein the reactive groups on the acetylenically unsaturated compounds are acetylenedicarboxylic acid or acetylenedicarboxylic diester, and the method further comprises converting the acetylenedicarboxylic acid or acetylenedicarboxylic diester into diglycol ester or the reactive groups on the acetylenically unsaturated compounds are dicarboxylic acid, and the method further comprises converting the dicarboxylic acid into carboxyaminoamide or carboxylic/amide salt. Support for Claim 9 can be found in the Application-as-filed, for example on Page 5, lines 16 through 34.

Claim 10 is directed to advantageous flame retardants having the structure



where R is independently selected from carboxyl, carboxyalkyl, carboxyaryl, hydroxyalkyl, alkoxyalkyl, aroxyalkyl, hydroxyaryl, alkoxyaryl or aroxyaryl. Support for Claim 10 can be found in the Application-as-filed, for example at Page 3, line 29 through Page 4, line 6.

Reexamination and reconsideration of this application, withdrawal of all rejections, and formal notification of the allowability of the pending claims are earnestly solicited in light of the remarks which follow.

*The Claimed Invention is Patentable
in Light of the Art of Record*

Claims 1 through 8 stand rejected over JP 01284521 to Matsumoto et al. ("Matsumoto"). Claim 6 stands further rejected as anticipated by Matsumoto.

It may be useful to briefly consider the claimed invention before addressing the merits of the rejection.

The present invention provides reactive compounds having (on average) more than one DOPO-residue per molecule ("poly-DOPO"), and preferably containing two DOPO-residues. It is prepared from a compound having a carbon-carbon triple bond, such as an alkynediol, an alkyne-dicarboxylic acid or an ester thereof. The 9,10-Dihydro-9-oxa-10-phospha-phenanthrene-10-oxide (DOPO) is reacted across this triple bond under the action of a suitable catalyst (such as a mercury or copper salt, an amine, for example triethylamine, or aluminum triisopropylate).

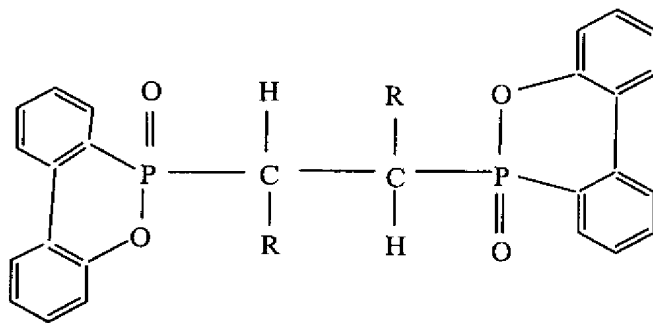
The reactive compound containing the DOPO radicals has further functional groups (i.e. reactive moieties), and are subsequently used as monomer which can be added during polymer production. In especially advantageous embodiments, the inventive monomers for producing copolyesters are tailored to contain hydroxy or carboxy groups (or derivatives thereof) and inventive

monomers for use in forming copolyamides are tailored to contain carboxamidoamides or carboxylic/amine salts, as reflected in new Claim 9.

A polyester or polyamide obtained from such monomers includes a plurality of DOPO radicals bound directly to the polymer backbone. These DOPO radicals are statistically distributed over the length of the polymer chain, since the poly-DOPO monomers are employed together with other monomers during polymer formation. Furthermore, the phosphorous content of each individual monomer is higher, e.g. two phosphorus moieties per molecule, due to the triple bond within the reactive compound used to form the monomer. The foregoing results in a polymer containing a higher weight proportion of DOPO than heretofore possible.

Such elevated amounts of DOPO are extremely beneficial, as the phosphorus in the DOPO acts as a flame retardant. A high amount of phosphorus is thus specifically desired in order to obtain more flame-resistant polymer. In the presently claimed process, the poly-DOPO imparts a superior flame retardancy to polymers produced therewith. In fact, when used as a comonomer, its proportion can be reduced (compared with a comonomer containing only one DOPO residue) without impairing the technical effect. Using a lower proportion is desirable, since the impact on the properties of the original polymers is smaller.

In especially advantageous embodiments, the inventive flame retardants have the general structure:



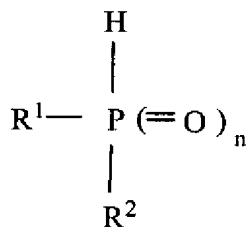
where R is independently selected from carboxyl, carboxyalkyl, carboxyaryl, hydroxyalkyl, alkoxyalkyl, aroxyalkyl, hydroxyaryl, alkoxyaryl or aroxyaryl, as recited in new Claim 10. In such advantageous embodiment, the recited presence of a triple bond, i.e. the acetylenically unsaturated bond, within the unsaturated reactive compound allows the addition of more than one DOPO moiety, i.e. advantageously two DOPO moieties, within a single reactive compound.

As noted above, this reactive compound may then be used as monomer (either as produced or as tailored to fit a particular reaction schemes) that can be added during polymer production. In this regard, the Examiner's attention is kindly directed to the Application-as-filed on Page 10, lines 1 through 19.

Matsumoto does not teach the claimed invention.

The flame retardant polyesters of Matsumoto are made in a different way and have a different chemical constitution. Matsumoto more particularly does not teach or suggest monomer containing a phosphorous moiety.

Matsumoto instead copolymerizes a polyester with 1 to 10 mol-% of an esterifiable unsaturated compound (particularly maleic anhydride, i.e. a carbon-carbon double bonded compound) at a reaction temperature not exceeding 200 °C in the presence of a polycondensation catalyst (GeO₂). Then, in a subsequent step, 0.7 to 1.0 equivalents, per equivalent of the unsaturated bonds of the unsaturated compound, of a phosphosphine or phosphine oxide of the formula



is added to the reaction mixture when the intrinsic viscosity reaches 0.25 to 0.48.

Accordingly, Applicants respectfully submit that the claimed invention is patentable in light of Matsumoto.

Matsumoto, adding phosphosphine or phosphine oxide to pre-formed polymers, does not teach or suggest the recited methods for producing flame retardant compounds containing poly-DOPO, much less the recited methods of reacting DOPO with acetylenically unsaturated compounds, and most certainly not such methods in which the reacting step is performed in the presence of a catalyst which is suitable for the addition of triple bonds. Matsumoto instead teaches away from the presently claimed flame retardant compounds, since he expressly teaches modification of an already existing polymer by merely adding a phosphine or phosphine oxide.

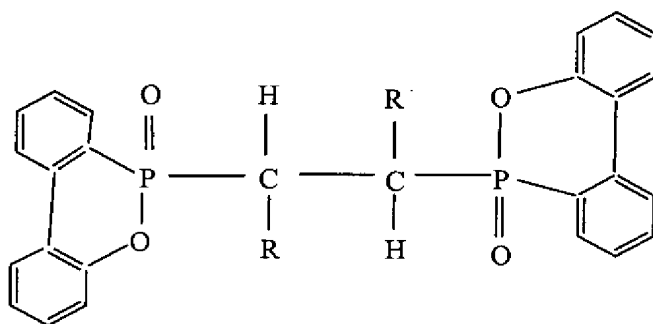
And Matsumoto, expressly teaching the incorporation of a maximum of 1.0 equivalents of phosphosphine or phosphine oxide, can not teach or suggest the claimed flame retardant compounds having a ration of 1.5 to 3 mol of DOPO per triple bond, as recited in Claim 2.

Applicant further respectfully submit that inventive polymers of Claim 6 are likewise patentable in light of Matsumoto. Applicants respectfully submit that the unsaturated compound of Matsumoto is added at a later stage of polycondensation and thus forms the end groups or is grafted onto an already existing polyester. The phosphine or phosphine oxide is thus attached to unsaturated compounds which are located at the end of the polyester chains and/or are grafted onto the polyester chains. It is not linked directly to the polyester main chain via a carbon-phosphorus bond, as is the case in the polymer obtained in the presently claimed process. Furthermore, the phosphorus-containing compound is not distributed regularly in the polyester of Matsumoto. The inventive products and those of Matsumoto are thus structurally very different from each other.

As Matsumoto merely teaches the addition of phosphosphine or phosphine oxide to pre-formed polymers, he most certainly does not teach or suggest advantageous methods for producing reactive organic compounds containing poly-DOPO as claimed in claim 9, which are specifically tailored for use as monomers in either polyester or polyamide production.

More specifically, Matsumoto does not teach or suggest methods for producing reactive organic compounds in which (i) the reactive groups on the acetylenically unsaturated compounds are acetylenedicarboxylic acid or acetylenedicarboxylic diester, and the method further comprises converting the acetylenedicarboxylic acid or acetylenedicarboxylic diester into diglycol ester (thus rendering it suitable as monomer for polyester production) or (ii) the reactive groups on the acetylenically unsaturated compounds are dicarboxylic acid, and the method further comprises converting the dicarboxylic acid into carboxyaminoamide or carboxylic/amide salt (thus rendering it suitable as monomer for polyamide production), as recited in Claim 9. As explained above, Matsumoto does not disclose any DOPO-containing monomers. And poly-DOPO monomers are not in any way contemplated.

Nor does Matsumoto, expressly teaching a maximum of 1.0 equivalent of phosphorous, teach or suggest advantageous flame retardants having the structure



where R is independently selected from carboxyl, carboxyalkyl, carboxyaryl, hydroxyalkyl, alkoxyalkyl, aroxyalkyl, hydroxyaryl, alkoxyaryl or aroxyaryl, as recited in Claim

10. In fact, Matsumoto teaches away from such advantageous embodiments, since he suggests to modify an already existing polymer having unsaturated double bond with a phosphine or phosphine oxide. There is no indication in the reference that more than one phosphine or phosphine oxide could be added to his maleic anhydride.

Nor would there have been any motivation to have produced the claimed reactive organic compounds based on Matsumoto. In contrast to the opinion urged within the Office Action at Page 5, first paragraph, at the time the instant invention was made, there would have been absolutely no motivation to have varied numerous significant factors, particularly in light of Matsumoto's express teaching of a maximum of 1.0 equivalent of phosphorus per unsaturated bond.

Furthermore, even if one had looked to Matsumoto (which Applicants did not) the claimed invention would not result. Matsumoto expressly requires the addition of phosphine or phosphine oxide to already formed polymer.

Accordingly, even if one had looked to Matsumoto (which, again, Applicants did not), the recited methods for producing flame retardant compounds containing poly-DOPO by reacting DOPO with acetylenically unsaturated compounds would not have resulted, and most certainly not such methods in which the reacting step is performed in the presence of a catalyst which is suitable for the addition of triple bonds. As noted above, Matsumoto instead teaches away from the presently claimed flame retardant compounds, since he expressly teaches modification of an already existing polymer by merely adding a phosphine or phosphine oxide

Accordingly, Applicants respectfully submit that the claimed invention is patentable in light of Matsumoto.

Consideration of Previously Submitted Information Disclosure Statement

It is noted that an initialed copy of the PTO/SB/08A that was submitted with Applicants' Information Disclosure Statement filed December 1, 2005 has not been returned to Applicants' representative with the Office Action. Accordingly, it is requested that an initialed copy of the PTO/SB/08A form be forwarded to the undersigned with the next communication from the PTO. In order to facilitate review of the references by the Examiner, a copy of the Information Disclosure Statement and the PTO/SB/08A form are attached hereto. Copies of the cited references were provided at the time of filing the original Information Disclosure Statement, and, therefore, no additional copies of the references are submitted herewith. Applicants will be pleased to provide additional copies of the references upon the Examiner's request if it proves difficult to locate the original references.

CONCLUSION

It is respectfully submitted that Applicants have made a significant and important contribution to the art, which is neither disclosed nor suggested in the art. It is believed that all of pending Claims 1 through 10 are now in condition for immediate allowance. It is requested that the Examiner telephone the undersigned if any questions remain to expedite examination of this application.

It is not believed that extensions of time or fees are required, beyond those which may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time and/or fees are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required is hereby authorized to be charged to Deposit Account No. 50-2193.

Respectfully submitted,

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